

### 3D speckle-tracking echocardiography in acute myocardial infarction: Relationship between contrast-enhanced magnetic resonance imaging and myocardial deformation

O. Huttin, D. Voilliot, S. Lemoine, M. Angioi, P.-Y. Marie, F. Moulin, Y. Juilliere, C. Selton-Suty  
CHU Brabois, Nancy, France

Speckle analysis of 3D echocardiography improves information on left ventricle (LV) segmental and global deformation by avoiding loss of speckles as it is the case in monoplane 2D analysis. Our goal was to evaluate the accuracy of 3D deformation parameters to detect myocardial delayed enhancement (MDE) transmural extent by cardiac magnetic resonance imaging (CMR) in myocardial infarction (MI).

**Patients.**— We included 72 patients ( $57.3 \pm 12.4$ yo) with first acute MI who underwent within 3 days following revascularization both CMR (GE 3T) and echocardiography (GE Vivid E9) including a 3D acquisition of full LV volume. Furthermore, 114 normal subjects ( $54.9 \pm 12.0$ yo) underwent a complete echocardiography. Automated analysis of 3D allowed the calculation of 3D global LV area (3DGAS), longitudinal (3DGLS), circumferential (3DGCS) and radial (3DGRS) strains (%). Peak systolic 2D and 3D S values from the 17 LV myocardial segments were recorded. For each segment MDE was defined as transmural ( $MDE > 66\%$ ), intermediate ( $33\text{--}66\%$ ) and subendocardial ( $< 33\%$ ). Pearson was used to study correlation between 2D, 3DSTE and CMR measurements. ROC analysis identified strain cut-off value predicting scar extent.

**Results.**— The 72 MI pts show a slightly decreased CMR-LVEF ( $46.3 \pm 9.5\%$ ) with a small infarct size (global scar extent  $20 \pm 13\%$ ). CMR identified 864 non-infarcted segments (75.2%) and 188 segments with transmural (16.2%), 80 with intermediate (7.0%) and 18 with subendocardial MDE (1.6%). A good tracking quality was obtained respectively in 87% and 93% of the segments in control and MI pts with good inter observer reproducibility (ICC 0.824 for 3DGLS and 0.945 for 3DGAS). All S values were significantly higher in control than in MI pts (3DGAS:  $-34.8 \pm 3.2$  vs.  $-26.0 \pm 5.8$ ; 3DGLS:  $-20.3 \pm 2.7$  vs.  $-14.1 \pm 3.7$ ; 3DGCS:  $-18.7 \pm 2.9$  vs.  $-14.8 \pm 3.8$ ; 3DGRS:  $54.6 \pm 9.9$  vs.  $39.3 \pm 11.8$ ,  $P < .0001$ ). All 3DGS values were correlated with CMR-LVEF (3DGLAS  $r = -0.715$ ; 3DGLS  $r = 0.602$ ; 3DGCS  $r = -0.64$ ; 3DGRS  $r = 0.66$ ; 2DGLS  $r = -0.652$ ; all  $P < 0.0001$ ). All 3D S values were significantly different between non-infarcted, subendocardial, intermediate and transmurally infarcted segments ( $P < 0.0001$ ) and were significantly lower in non-infarcted segments of MI patients than in segments of control pts. The optimal cut-off value for segmental 3DAS to predict a transmural extent vs. control was  $-26\%$  with a sensitivity of 86.7% and a specificity of 85.6% (AUC:0.92).

3D speckle imaging is an interesting tool in the acute phase of MI and 3D area strain seems the most valuable parameter, both as a global marker of LV dysfunction and as a regional marker of transmural scar.

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24

### Assessment of myocardial viability after acute myocardial infarction by global longitudinal 2d strain at rest and during low dose dobutamine stress echocardiography: Comparison with cardiac magnetic resonance imaging

I. Levy, S. Aboudi, C. Renard, C. Szymanski, D. Mataquin, L. Leborgne, C. Tribouilloy  
CHU d'Amiens, Amiens, France

**Background.**— Myocardial viability can be assessed by several imaging methods including low dose dobutamine stress echocardiography (DSE) and contrast-enhanced magnetic resonance imaging (Ce-MRI). DbE is a widely available and low cost approach but its assessment remains subjective and relies on semiquantitative evaluation of endocardial excursion and wall thickening, requiring adequate training.

Recent software provides fast and accurate quantification of myocardial strain using 2D speckle tracking. Thus, we sought to compare the results of 2D global and segmental strain both at rest and during low dose DSE to Ce-MRI for the assessment of myocardial viability after acute Myocardial infarction (MI).

**Patients and results.**— Between 2011 December and April 2012, we included 12 consecutive patients aged  $52 \pm 12$  (92% men) who had a coronary angioplasty in the acute phase of MI. One month after MI, all patients had DSE and Ce-MRI on the same day. Left ventricular ejection fraction (EF) at rest assessed in MRI correlated to both biplane echocardiographic EF ( $48 \pm 12\%$  vs.  $50 \pm 12\%$ ,  $r = 0.9$ ,  $P = 0.001$ ) and global longitudinal strain (GLS) ( $-15 \pm 5\%$ ,  $r = 0.68$ ,  $P = 0.016$ ). A 17 segments model was used. Two hundred and four left ventricular segments were studied in both MRI, conventional echocardiography and 2D strain, and were divided in three groups according to the result of Ce-MRI: 131 (64%) segments were considered normal, 25 segments (12%) had non-transmural enhancement (NTM) and 48 segments (24%) had transmural enhancement (TM). Peak longitudinal strain (LS) at rest was significantly reduced in NTM and TM segments compared to normal segments ( $-10 \pm 7\%$  vs.  $-18 \pm 5\%$ ,  $P = 0.0001$ ). However, LS at rest was not statistically different between NTM and TM segments ( $-12 \pm 6\%$  vs.  $-9 \pm 7\%$ ,  $P = 0.19$ ). GLS during low dose DSE tended to be higher in NTM segments than in TM segments ( $-16 \pm 7\%$  vs.  $-12 \pm 8\%$ ,  $P = 0.05$ ). At rest, a normal LS  $\leq -18\%$  in a segment allowed to predict the absence of NTM or TM scar with a sensibility of 49%, a specificity of 84%, a predictive positive value of 84% and a predictive negative value of 47%.

**Conclusion.**— Conventional DSE provides a reliable assessment of myocardial viability after acute MI compared to Ce-MRI. Isolated longitudinal myocardial deformation analysis may improve segmental analysis but failed to discriminate TM from NTM extent of MI. Radial or circumferential strain analyses may be mandatory to improve the performance of DSE to predict viability.

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25

### Usefulness of exercise echocardiography to predict onset of resting pulmonary hypertension in patients with scleroderma

D. Voilliot, J. Magne, R. Dulgheru, C. Henry, P. Lanzelotti  
Université de Liège, CHU Sart-Tilman, Liège, Belgium

**Objectives.**— Resting pulmonary hypertension (PH) is a powerful determinant of poor outcome in patients with systemic scleroderma (SSc). In various cardiac diseases, exercise-induced PH (EIPH) is considered as an early stage of resting PH, and may predict the occurrence of adverse events. We hypothesized that the presence of EIPH is a predictor of the onset of resting PH in patients with SSc. **Patients and methods.**— Thirty-three patients with diagnosis of SSc disease were prospectively submitted to comprehensive both resting and exercise stress echocardiography between January 2009 and November 2012.

Resting PH was defined as a transtricuspid pressure gradient (TTG)  $\geq 30$  mmHg, and EIPH as TTG  $\geq 40$  mmHg. Patients were

prospectively follow-up and regularly performed resting echocardiography.

**Results.**— There was a significant increase in TTG from rest to exercise ( $21.5 \pm 7.7$  vs.  $37.5 \pm 15.2$ ,  $P < 0.001$ ). There were two patients with baseline resting PH (6%) and 15 patients with EIPH (45%). Of note, all patients with resting PH have developed EIPH. Mean follow-up was  $25 \pm 13$  months (from 1 to 52) and six patients have experienced resting PH during this period, resulting in a mean time interval between baseline echocardiography and occurrence of resting PH of  $8 \pm 7$  months (from 1 to 18). Of interest, all patients who developed resting PH during the follow-up have baseline EIPH (60%). In contrast, none of patients without baseline EIPH developed resting PH during the follow-up (0%). Although patients who developed resting PH had significant higher baseline resting TTG ( $26.6 \pm 4.0$  vs.  $17.8 \pm 5.7$ ,  $P = 0.03$ ), the difference in baseline exercise TTG was markedly higher ( $53.7 \pm 14.0$  vs.  $31.4 \pm 11.9$ ,  $P = 0.001$ ). Using logistic regression, after adjustment for age, baseline EIPH was independently associated with the occurrence of resting PH during the follow-up ( $P = 0.0014$ ).

**Conclusion.**— EIPH may be frequent in SSC patients and could be a predictive factor of rapid and early onset of resting PH. Exercise stress echocardiography may be useful to identify subset of patients at high risk to developed resting PH and thus, could benefit from more aggressive therapeutic strategy. Nevertheless, further data in larger cohort are needed to confirm our results.

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26

### **Non-invasive detection of tako-tsubo cardiomyopathy versus acute anterior myocardial infarction by transthoracic doppler echocardiography**

P. Meimoun, V. Charles, G. Flahaut, J. Clerc, A. Luyck-Bore, H. Zemir, F. Elmkies  
Centre Hospitalier Compiègne, Compiègne, France

Typical tako-tsubo cardiomyopathy (TTC) mimics acute anterior myocardial infarction (AMI) and the differential diagnosis is challenging before coronary angiography (CA) is performed: it demonstrates reduced or absent antegrade flow in the left anterior descending artery (LAD) in AMI whereas there is no such flow limiting in TTC. At the acute phase, we tested the usefulness of non-invasive coronary flow velocity (CFV) visualization by transthoracic Doppler echocardiography (TDE) to distinguish between these two diseases. For this purpose, we prospectively enrolled 28 consecutive patients (pts) with TTC ( $75 \pm 10$  years, 93% females), which were compared to 28 consecutive pts with AMI treated successfully by primary angioplasty ( $66 \pm 12$  years, 79% females). All pts underwent assessment of CFV in the distal part of the LAD just before CA, using color and pulsed wave TDE. In addition, the symmetric involvement of wall motion abnormalities (WMA) based on the extent of the disease far beyond one coronary territory in TTC was searched by TDE.

**Results.**— The distal LAD CVF was visible in 38/56 cases (68%) in the whole population, in all cases with TTC (100%) and in 10 cases with AMI (36%). The sensitivity (Se) and specificity (Sp) of the LAD CFV visualization for the diagnosis of TTC were 100% and 64% respectively with a diagnostic accuracy of 82%. By comparison, the pattern of WMA yielded a Se of 75%, Sp of 86%, and a diagnostic accuracy of 80%, this pattern being inconclusive in 11 cases. When CFV and pattern of WMA were combined together the Se and Sp were 75% and 96% respectively, with a diagnostic accuracy of 86% to detect TTC. The assessment of right ventricular WMA and left ventricular obstruction did not improve the diagnostic value of the combination of the above tools.

**Conclusion.**— Non-invasive evaluation of CFV in the distal LAD could be helpful to differentiate TTC from AMI, and its combination with the pattern of WMA improved slightly its diagnostic accuracy.

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